AMENDMENTS TO THE CLAIMS

This listing of claims replaces all prior versions, and listings, of claims in the application.

1. (Currently Amended) A method for increasing or decreasing the ion conductivity of a membrane, which method comprises inserting one or more directly light-controlled ion channels into a membrane, wherein the one or more directly light-controlled ion channels is a biological photoreceptor, and wherein the one or more directly light-controlled ion channels comprises an apoprotein and a light-sensitive polyene covalently bound to the apoprotein, said polyene interacting with the apoprotein and functioning as a direct light-sensitive gate, thereby increasing or decreasing the ion conductivity of the membrane.

2. (Previously Presented) The method of claim 1, wherein the apoprotein is a transmembrane protein with 5 or more transmembrane helices.

3. (Currently Amended) The method of claim 1, wherein the directly light-controlled ion channel is a transport system for protons, sodium, or calcium.

4. (Previously Presented) The method of claim 1, wherein the apoprotein is an opsin protein or a derivative or fragment of a naturally occurring opsin protein.

5. (Previously Presented) The method of claim 4, wherein the opsin derivative or fragment is the result of an exchange and/or an insertion and/or deletion of one or several amino acid(s) in the natural amino acid sequence of the opsin protein.

6.-8. (Cancelled)

9. (Currently Amended) The method of claim 1, wherein the apoprotein is ~~derived from lower plants~~ an opsin protein from *Chlamydomonas reinhardtii*.

10.-12. (Cancelled)

13. (Withdrawn) The method of claim 1, wherein the apoprotein includes at least amino acids 24 to 268 of the Channelopsin2 (CHOP-2) protein (SEQ ID NO: 2).

14. (Withdrawn) The method of claim 1, wherein the apoprotein includes at least amino acids 24 to 268 of the Channelopsin2 (CHOP-2) protein (SEQ ID NO: 2), except that the histidine at position 134 of SEQ ID NO: 2 is replaced by another amino acid.

15. (Withdrawn) The method of claim 14, wherein the histidine at position 134 of SEQ ID NO: 2 is replaced by arginine.

16. (Withdrawn) The method of claim 4, wherein that the opsin protein derives from protozoa.

17. (Withdrawn) The method of claim 4, wherein that the opsin protein derives from bacteria or archaea.

18. (Withdrawn) The method of claim 4, wherein that the opsin protein derives from fungi.

19. (Previously Presented) The method of claim 1, wherein the light-sensitive polyene is a retinal or retinal derivative.

20. (Previously Presented) The method of claim 19, wherein the retinal derivative is selected from the group consisting of 3,4-dehydroretinal, 13-ethylretinal, 9-dm-retinal, 3-hydroxyretinal, 4-hydroxyretinal, naphthylretinal; 3,7,11-trimethyl-dodeca-2,4,6,8,10-pentaenal; 3,7-dimethyl-deca-2,4,6,8-tetraenal; 3,7-dimethyl-octa-2,4,6-trienal; and 6-7 rotation-blocked retinals, 8-9 rotation-blocked retinals, and 10-11 rotation-blocked retinals.

21. (Previously Presented) The method of claim 1, wherein the proton, sodium, or calcium conductivity of a membrane is increased or decreased.

22. (Previously Presented) The method of claim 1, wherein the membrane potential of a cell membrane is increased or decreased.

23. (Previously Presented) The method of claim 1, wherein the membrane is a cell membrane of a yeast.

24. (Previously Presented) The method of claim 1, wherein the membrane is a cell membrane of a mammalian cell or an insect cell.

25. (Previously Presented) The method of claim 20, wherein the concentration gradient of ions across the membrane is raised or lowered.

26. (Previously Presented) The method of claim 25, wherein the concentration gradient of protons, sodium, or calcium across the membrane is raised or lowered.

27.-31. (Cancelled)

32. (Previously Presented) The method of claim 23, wherein the yeast is *Saccharomyces cerevisiae, Schizosaccharomyces pombe,* or *Pichia pastoris.*

33. (Previously Presented) The method of claim 24, wherein the mammalian cell is a COS cell, a BHK cell, a HEK293 cell, a CHO cell, a myeloma cell, an MDCK cell, or a neuron.

34. (Previously Presented) The method of claim 24, wherein the insect cell is a baculovirus-infected sf9 cell.

35. (Currently Amended) The method of claim 20, wherein a light-induced membrane depolarization is realized by lowering the ion conductivity of the membrane by activating the one or more directly light-controlled ion channels by exposure to light.

36. (New) A method for increasing or decreasing the ion conductivity of a membrane, which method comprises inserting one or more directly light-controlled ion channels into a membrane, wherein (i) the one or more directly light-controlled ion channels is a biological photoreceptor, (ii) the one or more directly light-controlled ion channels comprises an apoprotein and a light-sensitive polyene covalently bound to the apoprotein, said polyene interacting with the apoprotein and functioning as a direct light-sensitive gate, and (iii) the apoprotein contains the consensus sequence L(I)DxxxKxxW(F,Y) (SEQ ID NO: 5), thereby increasing or decreasing the ion conductivity of the membrane.

37. (New) A method for increasing or decreasing the ion conductivity of a membrane, which method comprises inserting one or more directly light-controlled ion channels into a membrane, wherein (i) the one or more directly light-controlled ion channels is a biological photoreceptor, (ii) the one or more directly light-controlled ion channels comprises an apoprotein and a light-sensitive polyene covalently bound to the apoprotein,

said polyene interacting with the apoprotein and functioning as a direct light-sensitive gate, and (iii) the apoprotein is an opsin protein from *Chlamydomonas reinhardtii*, thereby increasing or decreasing the ion conductivity of the membrane.

38. (New) A method for increasing or decreasing the ion conductivity of a membrane, which method comprises inserting one or more directly light-controlled ion channels into a membrane, wherein (i) the one or more directly light-controlled ion channels is a biological photoreceptor, (ii) the one or more directly light-controlled ion channels comprises an apoprotein and a light-sensitive polyene covalently bound to the apoprotein, said polyene interacting with the apoprotein and functioning as a direct light-sensitive gate, and (iii) the apoprotein includes at least amino acids 61 to 310 of the Channelopsin1 (CHOP-1) protein (SEQ ID NO: 1), thereby increasing or decreasing the ion conductivity of the membrane.